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NATIONAL MARINE FISHERIES SERVICE
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CRUISE RESULTS

Cruise 86-1 Alaska
Cruise 86-2 Morning Star
1986 Bering Sea Crab And Groundfish Survey
June-August 1986

The 1986 Bering Sea crab and groundfish survey was completed by Northwest and Alaska Fisheries Center (NWAFC) personnel during the period June-August 1986. The survey consisted of several elements. The standard Bering Sea crab and groundfish bottom trawl survey, completed annually, was performed by the U.S. stern trawler Morning Star and the research vessel Alaska. This survey consisted of 354 stations on the continental shelf (depths less than 180 m) between Unimak Pass and St. Matthew Island during the period June-August (Figure 1). In addition to this major survey work, several other experiments and studies were conducted.

OBJECTIVES

The objectives of the 1986 NWAFC bottom trawl survey were to:

1. Continue the annual series of bottom trawl surveys to assess crab and groundfish resources on the eastern Bering Sea continental shelf from Unimak Pass to St. Matthew Island.
2. Complete additional experiments as time permitted, including the tagging of Pacific cod, collection of fish stomachs for feeding studies, collection of Alaska plaice samples for population studies, collection of data to determine the type and amount of man-made debris occurring on the Bering Sea floor, and the collection of requested fish and invertebrate taxa samples for various research organizations and investigations.



VESSELS AND GEAR

The 30.5 m research vessel Alaska is a house-forward stern trawler and the 37.5 m Morning Star is a house-forward crabber/trawler. The vessels were equipped with modern trawling systems and adequate fishing electronics.

Both vessels were equipped with 83-112 eastern trawls as modified in 1982. These nets have a 25.3 m (83 ft.) headrope and a 34.1 m (112 ft.) footrope. They were towed behind 1,000 kg, 1.8 X 2.7 m steel V-doors and 54.9 m paired dandyline. Each lower dandyline had a 0.18 m chain extension connected to the lower wing edge to improve bottom tending characteristics. The trawl towed by the Morning Star was found to have a mean towing width of 16.5 m as determined by gear mensuration tests during the cruise. The trawl towed by the Alaska was assumed to have a mean towing width of 16.4 m as measured in 1983.

SURVEY DESIGN AND METHODS

The eastern Bering Sea shelf is surveyed annually based on a 20 X 20 nmi grid. The standard survey has 329 stations (131,600 nmi²) located in the center of these grid squares (Figure 1). Higher density sampling is performed around the Pribilof Islands and St. Matthew Island by sampling the corners of the grids to more adequately sample crab stocks. These additional 26 stations bring the total to 355 stations. During 1986, 354 of these stations were successfully sampled. The survey is designed for two vessels to begin the survey on adjoining columns of stations at the eastern end of Bristol Bay. The vessels then sample alternate columns moving westerly across the shelf. This alternate column design allows the use of statistical techniques to determine differences in relative fishing power between the two vessel/gear combinations.

In 1986, the vessel Alaska began the survey on June 4, and the vessel Morning Star began the survey on June 3. The standard sampling plan was used until July 11 when the Alaska's part of the survey was completed. The remainder of the survey was completed by the Morning Star. The vessel Alaska sampled stations from inner Bristol Bay to approximately 172° W, and the Morning Star sampled stations from inner Bristol Bay to approximately 177° W.

At the request of fishing industry representatives, the Morning Star sampled 6 stations during June 5-6 in inshore waters near Port Moller, Alaska. These samples were made to investigate king crab by-catch rates in the area of a proposed Pacific cod fishery.

Initial sampling during the standard survey revealed extreme variability in the distribution of red king crab. After completing the standard survey, the Morning Star was dispatched to inner Bristol Bay for additional sampling to more precisely delineate this distribution.

The survey schedule for each vessel was as follows:

Alaska

June 4-July 11 Survey the continental shelf from inner Bristol Bay, westward to the middle of the shelf.

Morning Star

June 3-June 5 Commence survey of the continental shelf from inner Bristol Bay, westward to the shelf edge.

June 5-June 6 Complete industry requested survey of inshore waters near Port Moller, Alaska.

June 7-August 1 Complete survey of the continental shelf westward to the shelf edge.

August 1-August 9 Resurvey sections of inner Bristol Bay.

RESULTS

The following assumptions and limitations concerning the survey data should be noted:

1. It is assumed that all fish in the path of the trawl are retained, while, in fact, some fish escape the trawl. Others are herded into the trawl by the action of the doors and dandy lines. In addition, some species, such as walleye pollock, have vertical distributions such that a significant portion of the stocks are above the net mouth. Adjustments are not made to the data to compensate for these biases.
2. For purposes of biomass estimations, each station is taken to be representative of the grid block and estimates are extrapolated to include the entire area.

Standard area

Walleye pollock was the most abundant fish species taken in the standard survey area with a mean catch rate of 107 kg/hectare trawled (Table 1). That catch rate was more than double the rate for the second ranked species, yellowfin sole (40 kg/ha). Pacific cod (24 kg/ha), rock sole (22 kg/ha), and Alaska plaice (12 kg/ha) were ranked 3rd through 5th, respectively. Pacific cod, walleye pollock, rock sole, flathead sole, and yellowfin sole were each found at over 70% of the stations in the standard area. A total of 1,915 Pacific cod were tagged during the survey.

Five commercially important crab species were taken during the standard survey. *Opilio tanner* crab, with a mean catch rate of over 65 crabs per

hectare trawled, was the most abundant crab species taken (Table 2). Bairdi tanner crab (5/ha) was ranked second; red and blue king crab and hair crab were ranked 3rd through 5th, each with a mean catch rate under 1/ha.

Inner shelf (less than 50 m depth)

The nearshore waters cover about 25% of the standard survey area. Fish catches within these waters were dominated by yellowfin sole (Table 3). The catch rate of 92 kg/ha was more than double the value for the second ranked species, walleye pollock (40 kg/ha). Rock sole, Pacific cod, and Alaska plaice were also abundant.

The crab catch was dominated by opilio (4/ha) and bairdi (2/ha) tanner crab. Red king, hair, and blue king crab were each taken at mean rates under 1/ha (Table 4).

Central shelf (50-100 m depth)

The large central shelf area covers about 45% of the standard survey area. Walleye pollock (82 kg/ha) and yellowfin sole (37 kg/ha) were abundant in these areas as well as the inner shelf (Table 3). Although the relative ranking and catch rates were different than on the inner shelf, those two species, combined with Alaska plaice, Pacific cod, and rock sole, comprised the major portion of the catches.

The opilio tanner crab mean catch rate of 136/ha was nearly 21 times larger than the rate for bairdi tanner crab, the second most abundant species. Red king crab were taken at rates of just over 1/ha, while blue king and hair crab were taken at rates substantially less than 1/ha (Table 4).

Outer shelf (100-200 m depth)

The waters at depths between 100 m and the shelf edge (about 200 m) cover approximately 30% of the standard survey area. Walleye pollock catch rates of 206 kg/ha were nearly 6 times larger than Pacific cod, the second most abundant species at 35 kg/ha (Table 3). Arrowtooth flounder and flathead sole, traditional deeper water species, had mean catch rates of 14 kg/ha.

Opilio (10/ha) and bairdi (4/ha) tanner crab were moderately abundant in this area and trace catches of blue king and hair crab were also taken (Table 4). Red king crab were not taken in these waters.

Distribution and Length Composition

The standard survey area of the eastern Bering Sea shelf supports a diverse fauna, as indicated by the 300 taxonomic entities identified in the catches. However, seven fish species and the purple-orange seastar made up nearly 85% of the cumulative catch. The five commercially important crab species collectively comprised 2%, by weight, of the cumulative catch.

Walleye pollock

Walleye pollock made up 40% of the total catch rate in the standard survey. Although they were distributed across almost the entire shelf, catch rates increased as depth increased. Rates were high in the southern areas of the shallow and intermediate depth zones and were highest in the northern portion of the deep depth zone. Walleye pollock catches on the shelf consisted of a wide range of size and age groups (Figure 2) dominated by relatively large fish (32-55 cm) with a strong secondary mode of age 1 fish (mean length approximately 12 cm).

Yellowfin sole

Yellowfin sole was the second most abundant fish species caught in the standard survey and made up approximately 15% of the total catch rate. Abundances were highest on the inner shelf, particularly to the south in Bristol Bay. Catch rates along the central shelf were moderately high but decreased to less than 1 kg/ha on the outer shelf. The length distribution shows a wide range of sizes from juveniles to large fish with a mean length of 25.9 cm (Figure 2).

Pacific cod

Pacific cod were rather evenly distributed across the shelf with slightly higher catches along the northern outer shelf and around the Pribilof Islands. They made up 9% of the total catch rate and catches consisted of a wide range of sizes and age groups. Length distribution modes occurred at 15, 31, and 55 cm and mean length was 41.7 cm (Figure 2).

Rock sole

Rock sole were distributed primarily in the southern portions of the inner and central shelf regions. Catches along the outer shelf were relatively small. The catch rate for rock sole represented about 8% of the total. The length distribution reflects an apparent good recruitment of younger fish based on the mode centered at about 22 cm (Figure 2).

Alaska plaice

Alaska plaice were distributed largely in the northern portions of the inner shelf and throughout the central shelf. Plaice made up about 4% of the total and survey catches were almost exclusively adult fish (Figure 2). The mean length of Alaska plaice was 34.6 cm.

Flathead sole

Flathead sole were most abundant in the deeper waters of the central and outer shelf. The mean catch rate represented about 3% of the total. The length distribution ranged from 6-52 cm with a mean value of 27.3 cm (Figure 2).

Arrowtooth flounder

Arrowtooth flounder were found primarily in the southern central area and outer shelf portions of the survey area. Catch rates increased to the south and as depth increased. The mean catch rate accounted for about 2% of the total. Several distinct modes could be seen in the length distribution, reflecting the high growth rate of this species (Figure 2). The mean length of arrowtooth flounder was 33.0 cm.

Opilio tanner crab

Opilio tanner crab were distributed primarily in the northern portions of the central shelf. Inner and outer shelf catch rates were considerably lower than central shelf rates (Table 4) but in each of these areas catch rates were larger in the north. The opilio tanner crab catch was 1.4%, by weight, of the total catch of all fish and invertebrates, combined.

Bairdi tanner crab

Bairdi tanner crab were distributed primarily along the north side of the Alaska Peninsula and along the shelf edge from Unimak Pass to the Pribilof Islands (Table 4). The catch rate for bairdi tanner crab was less than 0.2%, by weight, of the combined total catch.

Red king crab

Red king crab comprised 0.3%, by weight, of the total catch. They were sparsely distributed in the southern portions of the central and inner shelf areas, primarily in Bristol Bay.

Blue king crab

Blue king crab were found primarily in the central shelf area north and east of the Pribilof Islands and St. Matthew Island (Figure 1) and comprised less than 0.04%, by weight, of the total catch.

Hair crab

Hair crab were distributed primarily to the east and northeast of the Pribilof Islands and in lower numbers along the southern edge of Bristol Bay. They comprised 0.02%, by weight, of the total catch.

SCIENTIFIC PERSONNEL^aAlaskaLeg 1

A. Shimada^b
 D. Fisk
 M. Bohle
 P. Anderson^c
 B. Dew^c

Leg 2

G. Walters^b
 J. Sassano
 R. Hoff
 R. MacIntosh^c
 F. Hartsock^c

Morning StarLeg 1

K. Halliday^b
 P. Wyman
 D. Milward
 V. Bryant
 B. Otto^c

Leg 2

W. Hirschberger^b
 K. Halliday
 D. Dwyer
 T. Armetta
 E. Munk^c

Leg 3

A. Shimada^b
 G. Lang
 D. Kessler
 P. Commiskey^c
 D. Zhu^d

- a Personnel from NWAFC, Seattle, unless otherwise noted
 b Chief Scientist
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 d Yellow Seas Fisheries Research Laboratory, Qingdao, Peoples' Republic of China

Table 1.--Catch rates (kg/ha) of commercially important fish species taken during the 1986 standard eastern Bering Sea survey.

<u>Species</u>	<u>kg/ha</u>
Walleye pollock	107.1
Yellowfin sole	40.2
Pacific cod	24.4
Rock sole	21.8
Alaska plaice	11.8
Flathead sole	7.6
Arrowtooth flounder	5.0
Pacific halibut	1.9
Sablefish	0.4
Greenland turbot	0.1

Table 2.--Catch rates (no/ha) of commercially important crab species taken during the 1986 standard eastern Bering Sea survey.

<u>Species</u>	<u>no/ha</u>
Opilio tanner crab	67.7
Bairdi tanner crab	4.7
Red king crab	0.9
Blue king crab	0.1
Hair crab	0.1

Table 3.--Catch rates (kg/ha) of commercially important fish species, by depth interval, taken during the standard eastern Bering Sea survey.

<u>Inner shelf</u> <u>< 50 m</u>		<u>Central shelf</u> <u>50-100 m</u>		<u>Outer shelf</u> <u>100-200 m</u>	
<u>Species</u>	<u>kg/ha</u>	<u>Species</u>	<u>kg/ha</u>	<u>Species</u>	<u>kg/ha</u>
Yellowfin sole	91.8	Walleye pollock	81.6	Walleye pollock	205.5
Walleye pollock	40.2	Yellowfin sole	36.7	Pacific cod	35.1
Rock sole	38.7	Rock sole	24.8	Flathead sole	14.3
Pacific cod	20.7	Alaska plaice	19.6	Arrowtooth fl.	14.1
Alaska plaice	10.9	Pacific cod	19.6	Pacific halibut	2.5
Pacific halibut	2.2	Flathead sole	6.9	Rock sole	2.2
Flathead sole	1.2	Arrowtooth fl.	1.9	Sablefish	1.2
Arrowtooth fl.	<0.1	Pacific halibut	1.3	Alaska plaice	0.6
		Greenland turbot	<0.1	Greenland turbot	0.4
		Sablefish	<0.1	Yellowfin sole	0.1

Table 4.--Catch rates (no/ha) of commercially important crab species, by depth interval, taken during the standard eastern Bering Sea survey.

Inner shelf < 50 m		Central shelf 50-100 m		Outer shelf 100-200 m	
<u>Species</u>	<u>no/ha</u>	<u>Species</u>	<u>no/ha</u>	<u>Species</u>	<u>no/ha</u>
Opilio t. crab	3.5	Opilio t. crab	136.3	Opilio t. crab	10.4
Bairdi t. crab	2.2	Bairdi t. crab	6.6	Bairdi t. crab	4.0
Red king crab	0.8	Red king crab	1.4	Blue king crab	< 0.1
Hair crab	0.1	Blue king crab	0.2	Hair crab	< 0.1
Blue king crab	< 0.1	Hair crab	0.1		

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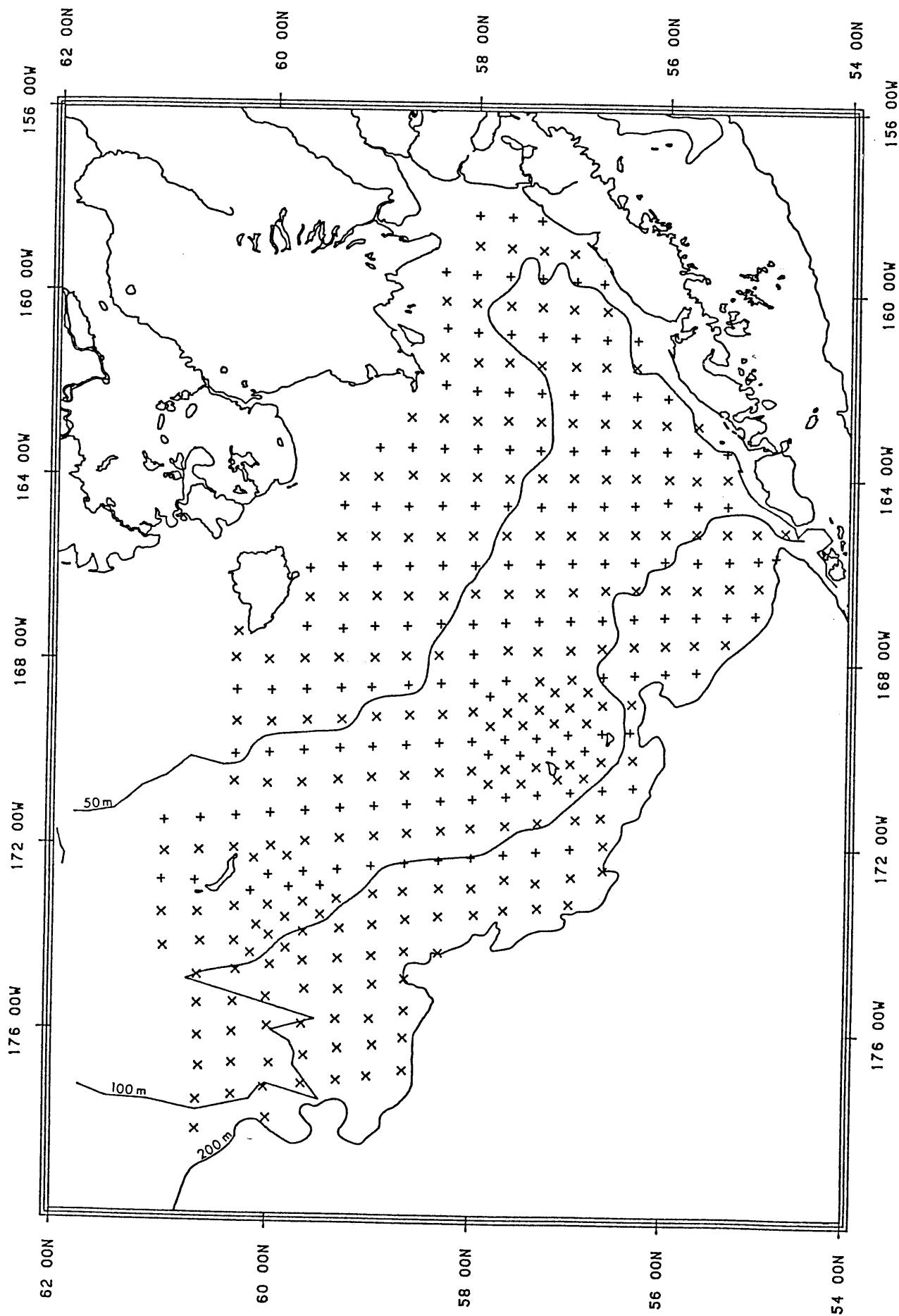


Figure 1.--Stations completed during the standard eastern Bering Sea survey in 1986 by the Alaska (+) and the Morning Star (X).

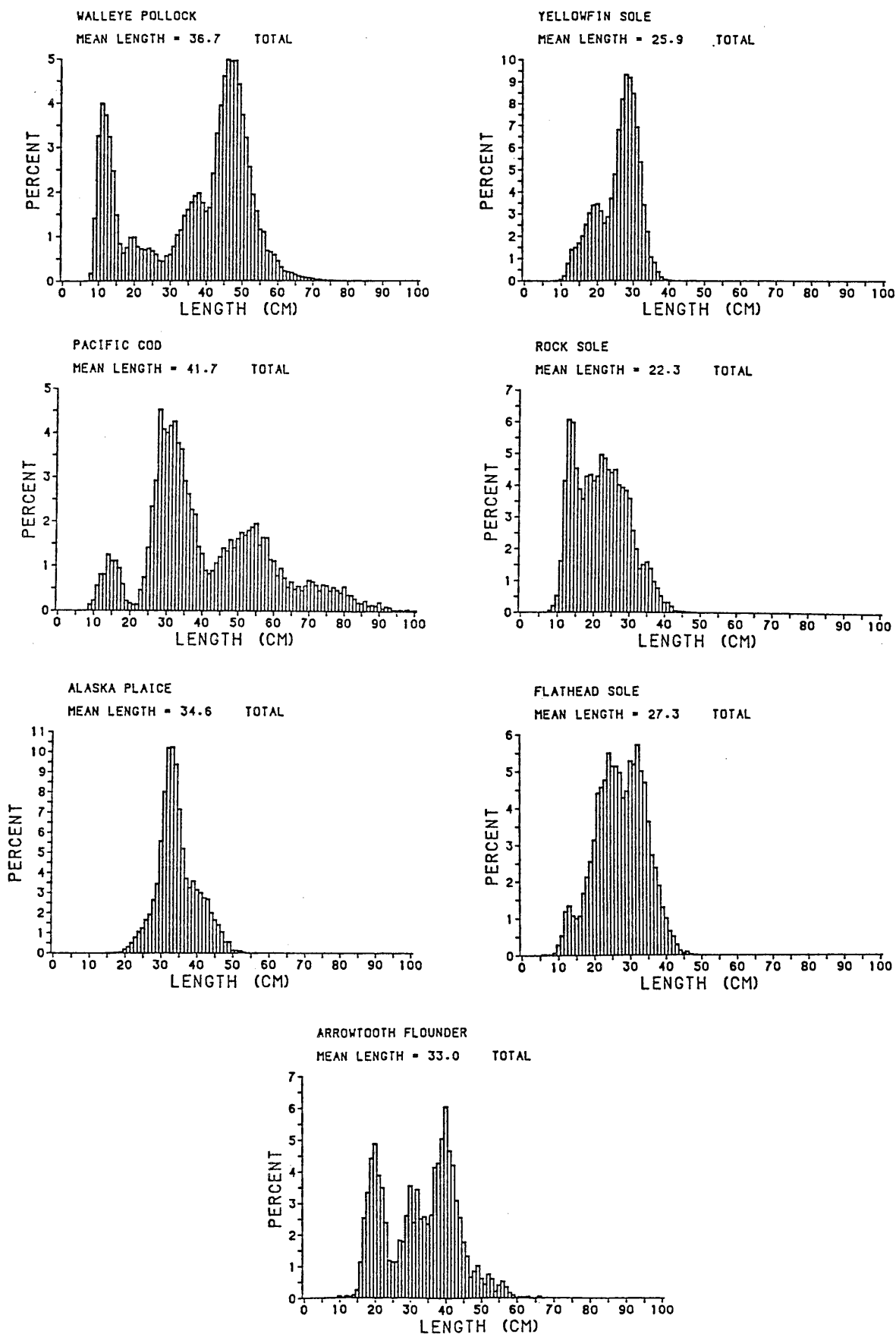


Figure 2.—Length distributions for major fish species during the 1986 eastern Bering Sea survey.